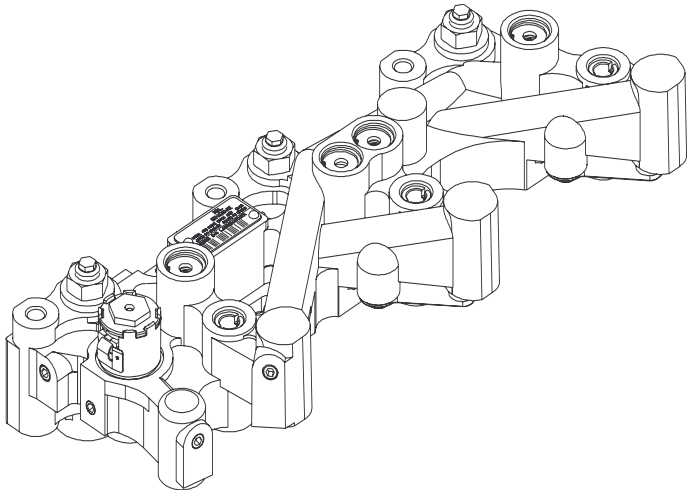
Jacobs Vehicle Systems™

CBRAKE By Jacobs™

Installation Manual For ISL98, ISL03, ISL07, ISC07



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Safety Precautions

The following symbols in this manual signal potentially dangerous conditions to the mechanic or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

⚠ WARNING

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

⚠ CAUTION

THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

NOTE:
INDICATES AN OPERATION, PROCEDURE OR INSTRUCTION THAT IS IMPORTANT FOR CORRECT SERVICE.

Fuels, electrical equipment, exhaust gases and moving engine parts present potential hazards that could result in personal injury. Take care when installing an engine brake. Always use correct tools and proper procedures as outlined in this manual.

⚠ WARNING

SEE DRIVER'S MANUAL FOR PROPER ENGINE BRAKE DRIVER TECHNIQUES.

THE CBRAKE BY JACOBS™ ENGINE BRAKE IS A VEHICLE SLOWING DEVICE, NOT A VEHICLE STOPPING DEVICE. IT IS NOT A SUBSTITUTE FOR THE SERVICE BRAKING SYSTEM. THE VEHICLE'S SERVICE BRAKES MUST BE USED TO BRING THE VEHICLE TO A COMPLETE STOP.

Aftermarket Kits

P/N	Brake Model	Engine	Desc.
4089653	490	ISL	12VDC Kit
4089626	490A	ISL03	12VDC Kit
4089626	490A	ISL07	12VDC Kit
4089626	490A	ISC07	12VDC Kit

Section 1: Introduction

Housing Identification

A nameplate attached to the top surface of the engine brake housing identifies the model number, part number, **front** or **rear** housing and housing serial number.

For housing part number and other replacement part information, refer to Cummins Bulletin No. 3401838, Jacobs Parts Manual, P/N 026301.

Part Number	Description	Engine Brake Compatible
3945615	Front Oil Fill, Valve Cover	No
3945436	Front Oil Fill, Valve Cover	Yes
3945834	Rear Oil Fill, Valve Cover	Yes
3945833	Rear Oil Fill, Valve Cover	No
3945970	Rear Oil Fill, Valve Cover	Yes
3945971	Front Oil Fill, Valve Cover	Yes
3991608	No Oil Fill, Valve Cover	Yes

Engine Identification

Prior to engine brake installation, verify that engine is an ISL ISL03, ISL07, or ISC07. The engine identification is on the serial number plate located on the fuel pump side below the rocker cover.

Application Notes

Engine Brakes should not be used in combination with an exhaust brake.

For 24 volt applications, order two (2) of 24V solenoid p/n 4089625 and stamp the brake data plate as 24V.

⚠ CAUTION

THE 490A BRAKE IS APPROVED FOR USE ON THE ISC07 ENGINE ONLY. THE 490A BRAKE IS NOT APPROVED FOR USE ON PRIOR ISC ENGINE MODELS

ISL03/ISL07/ISC07

On the ISL03 engine the valve cover must be replaced when installing a engine brake. The valve cover is not included in the aftermarket kit and should be ordered seperately. Replace short valve cover 3967770 with tall cover 3967777 (front fill),3967763 with 3967773 (rear fill), or 3967766 with 3967776 (no oil fill).

ISL

When installing an engine brake on the ISL engine a new turbo actuator is required due to increased backpressure. Actuator kit 4030234 needed for turbos 3597581, 3597586, 3597600; kit 4030233 needed for turbos 3597576, 3597584.
All other turbos — no actuator change needed.

Some valve covers are not engine brake compatible and will need to be replaced during installation. Please verify your valve cover is compatible.

Special Tools

The following special tools should be available for the installation:

1. Torque 6 in-lb wrench, Cummins P/N 3376592.

2. Engine Barring tool Cummins P/N 3824591.

3. Feeler gage/slave piston:
   Cummins P/N 3613681, (0.090")

Recommended Torque Values

Mounting Spacer	60 N.m (45 lb-ft.)
Hexagonal Flange Head cap screw (P/N 3945232)	60 N.m (45 lb-ft.)
Oil Supply Screw	7 N.m (5 lb-ft.)
Hexagonal Flange Head cap screw (P/N 3927064)	32 N.m (23 lb-ft.)
Cap, Adj Nut	35 N.m (25 lb-ft.)
Nut, Valve Adj	35 N.m (25 lb-ft.)
Nut, D-Lash	35 N.m (25 lb-ft.)

⚠ CAUTION

UNLESS OTHERWISE SPECIFIED, THE TORQUE VALUES LISTED IN THE TEXT ARE DIRECT VALUES USING NO TORQUE WRENCH ADAPTERS OR EXTENSIONS. WHEN ADAPTERS OR EXTENSIONS ARE USED WITH A TORQUE WRENCH, THE TORQUE VALUES MUST BE ADJUSTED FOR THE SPECIFIC TOOLS BEING USED. FOLLOW THE MANUFACTURER'S RECOMMENDED PROCEDURES FOR THE TORQUE WRENCH AND ADAPTER BEING USED.

Automatic Transmissions

⚠ CAUTION

PRIOR TO INSTALLATION OF THE ENGINE BRAKE ON VEHICLES WITH AUTOMATIC TRANSMISSIONS, WE RECOMMEND THAT THE TRANSMISSION MANUFACTURER REPRESENTATIVE (DEALER) BE CONSULTED TO BE SURE OF THE COMPATIBILITY OF THE ENGINE BRAKE WITH THE SPECIFIC AUTOMATIC

Section 2: Engine Preparation

Clean engine thoroughly. Remove engine valve cover and gasket. Retain all parts.

Crosshead and Adjusting Screws

1. Remove the plastic pump drive cover located on the front of the engine. This will expose the fuel pump gears and timing marks (Fig. 1).

2. Using the barring tool, Part No. 3824591, rotate the crankshaft to align the mark on the fuel pump gear with the top dead center mark on the gear cover (Fig. 2).

3. Remove Intake rocker lever mounting studs on cylinders 1 and 4. Replace with new engine brake oil supply studs. Torque to 60 N•m [45 ft-lb].

4. Adjust intake lash 0.305 mm [0.012 in] on cylinders 1, 2, and 4.

   NOTE: REFERENCE ENGINE MANUAL FOR INSTRUCTION ON SETTING INTAKE VALVE LASH.

5. Remove exhaust rocker lever mounting studs on Cylinders 1, 3, and 5.

6. Remove exhaust crossheads and replace with CBrake by Jacobs Cross™heads (Fig. 3).

7. Install new exhaust rocker lever mounting studs (these will accept the engine brake mounting bolts). Torque to 60 N•m [45 ft-lb].

8. Remove exhaust rocker adjusting screw locknut on cylinders 1,3, and 5. Replace lock nuts with longer lock nut provided in the kit. Do not tighten at this time.

9. Adjust the exhaust valve lash to 0.559 mm [0.022 in] on cylinders 1, 3, and 5. Tighten locknut to 25 N•m [20 ft-lb]. Install spherical nut onto long lock nut and torque to 40 N•m [30 ft-lb].

   NOTE: REFERENCE ENGINE MANUAL FOR INSTRUCTION ON SETTING EXHAUST VALVE LASH.

10. Check exhaust valve lash on cylinders 1, 3, and 5. Adjustment may have moved when torquing the spherical nut. Readjust as necessary.

11. Using the engine barring tool, Part No. 3824591,rotate the crankshaft 360 degrees to align the mark on the fuel pump gear with the mark on the gear cover that is 180 degrees away from top dead center (Fig. 4).

12. Adjust intake lash 0.305 mm [0.012 in] on cylinders 3, 5, and 6.

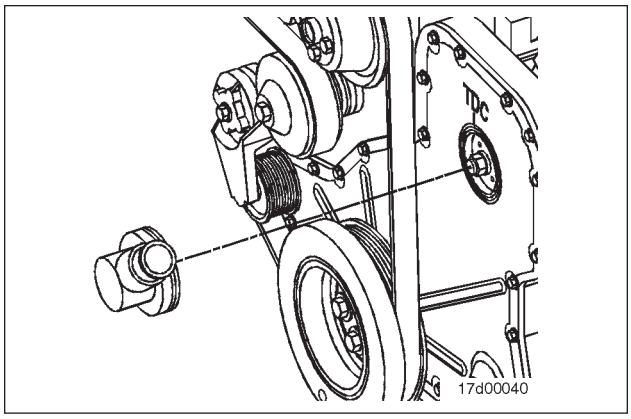


FIG. 1

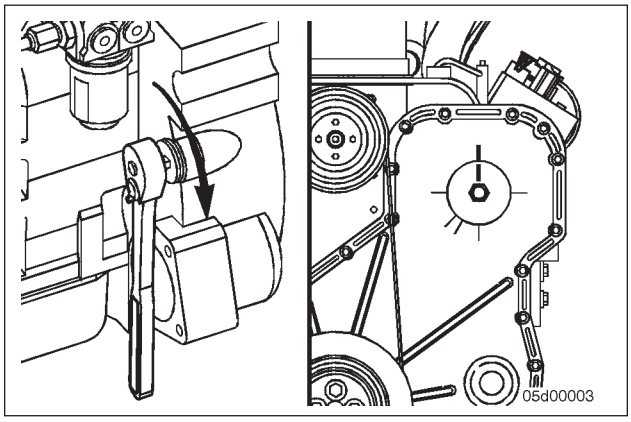


FIG. 2

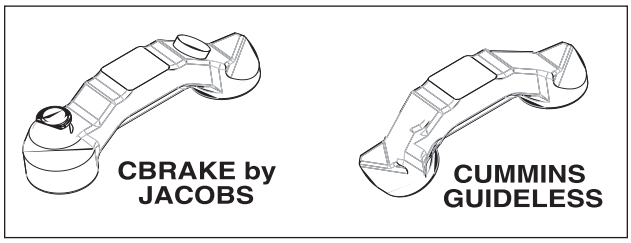


FIG. 3

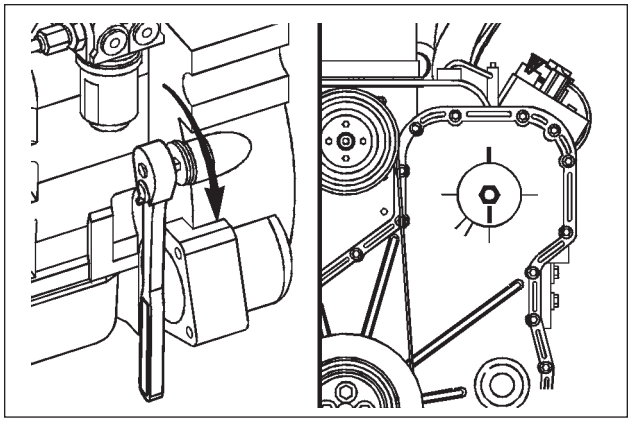


FIG. 4

13. Remove exhaust rocker lever mounting studs on cylinders 2,4, and 6.

14. Remove exhaust crossheads and replace with CBrake by Jacobs™ crossheads (Fig. 3).

15. Install new exhaust rocker lever mounting bolts (these will accept the engine brake mounting bolts). Torque to 60 N•m [45 ft-lb].

16. Remove exhaust rocker adjusting screw locknut on cylinders 2,4, and 6. Replace locknuts with longer lock nut. Do not tighten at this time.

17. Adjust the exhaust valve lash (0.559mm / 0.022in) on cylinders 2, 4, and 6. Tighten locknut to 25 N•m [20 ft-lb]. Install spherical nut onto long lock nut and torque to 40N•m [30 ft-lb].

18. Inspect exhaust valve lash on cylinders 2, 4, and 6. Adjustment may have moved when torquing the spherical nut. Readjust as necessary.

19. Install six brake mounting spacer studs into pretapped holes. Torque to 60 N•m [45 ft-lb].

Section 3: Engine Brake

Engine Brake Installation

1. Make sure the housing adjusting sleeves are flush with the bottom of the housing or recessed.

2. Apply oil to the oil supply screw o-rings and slide housings down and into position.

3. Place 3 mounting bolts in the mounting bolt holes on the slave piston side of the brake housing (next to slave piston adjusting screws). Tighten the three bolts to 7 N•m [5 ft- lb] (Fig. 5).

4. Screw down the three housing adjusting sleeves until they just make contact with the rocker arm pedestals.

5. Place the 3 remaining mounting bolts with hardened washers into the adjusting sleeves and hand tighten. Brake should be flat on rocker arm pedestal and spacer. Torque the 6 mounting bolts to 32 N•m [23 ft-lb].

6. Install electrical harness from each engine brake solenoid to the spacer pass-through connector.

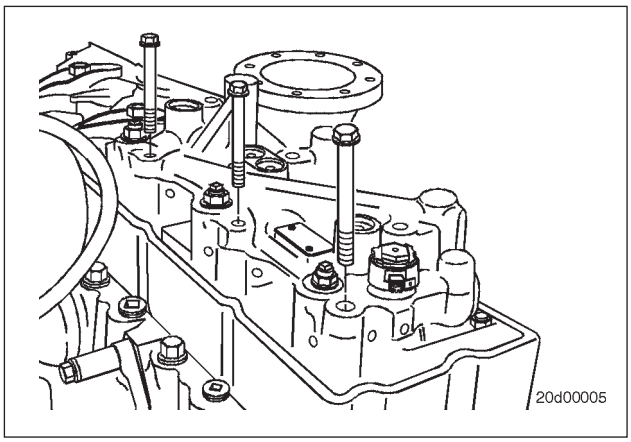


FIG. 5

For ISL98 Only: Spacer Installation

1. Clean rocker housing. Apply sealant to spacer. Place spacer on position.

2. Hand start the five spacer bolts (these will accept the cover screws). Starting from the center and proceeding outward on both sides torque the bolts to 32 N•m [23 ft-lb].

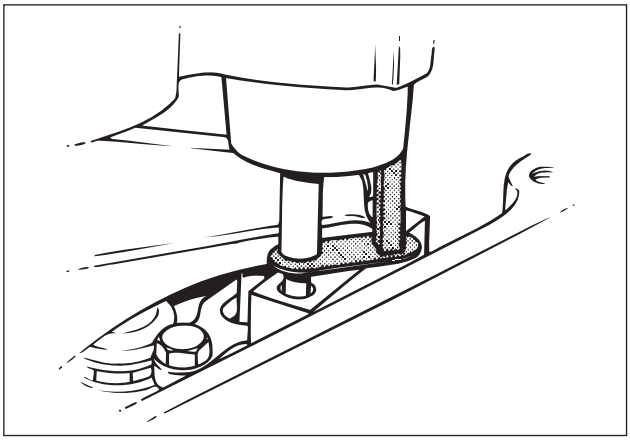


FIG. 6

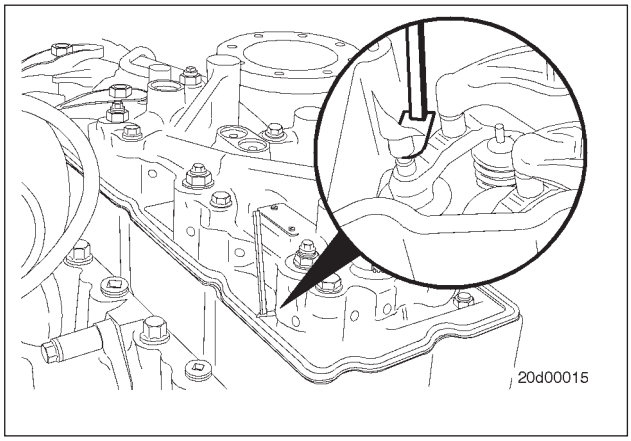


FIG. 7

Slave Piston Adjustment

NOTE: ADJUST THE SLAVE PISTON CLEARANCE WITH THE ENGINE STOPPED AND COLD. STABILIZED WATER TEMPERATURE OF 140° F. (60° C.) OR BELOW. EXHAUST VALVES, ON THE CYLINDER TO BE ADJUSTED, MUST BE IN THE CLOSED POSITION.

1. The TDC mark on the fuel pump gear should already be at 180 degrees from TDC. In this position the engine brake slave lash on cylinders 2, 4, and 6 can be set. (Fig. 8)

2. Insert the appropriate brake lash feeler gauge (P/N 3163681(0.090”) between the brake slave piston and exhaust head pin on cylinder one.

3. Using the 6 in-lb torque wrench, P/N 3376592, tighten the adjusting screw until the torque wrench “clicks” or if not using a torque wrench, until drag is felt on the feeler gage.

4. Using two wrenchs, hold the adjusting screw and tighten the locknut to 35 N•m [26 ft-lb]. If a light drag is not felt on the feeler gage readjust as necessary.

5. Repeat steps 2-4 for cylinders 4 and 6.

6. Using the barring tool, Part No. 3824591, rotate the crankshaft to align the mark on the fuel pump gear with the top dead center mark on the gear cover (12 o’clock) (Fig 29).

7. When the engine is in the top dead center position, Slave Piston Lash can be set on cylinders 1,3, and 5.

8. Repeat steps 2-4 for cylinders 1,3,and 5.

9. Install the plastic drive cover located on the front of the engine.

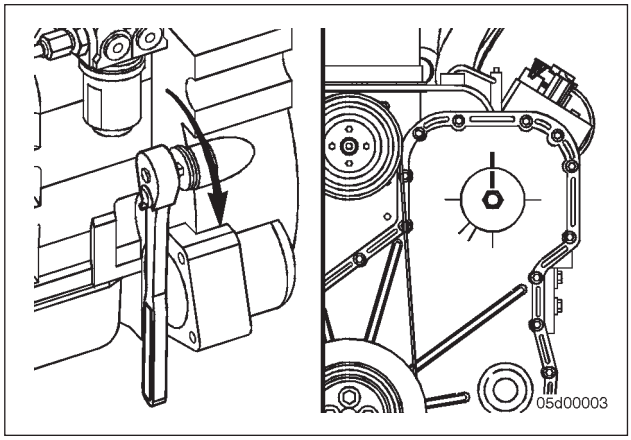


FIG. 8

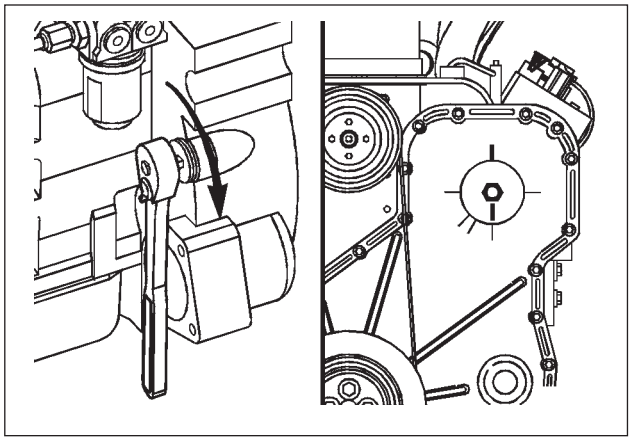


FIG. 9

Section 4: Electrical Installation

ISL Wiring Installation

For proper electrical wiring installation, make all electrical connections as shown in Figure 10, 11, 12 and 13 observing the following:

1. Connect the compression brake jumper harness connector to the existing breakout from the engine harness connector. Connect the two leads to the out side of the engine brake spacer.
2. All connections between the Cummins ECM (Electronic Control Module) and the engine brake ON/OFF switch are made with wiring provided by the installer.
3 Optional HI/LOW switches are to be made with wiring provided by the installer and plugged in place of the jumper plug.

Wiring for Manual Transmissions

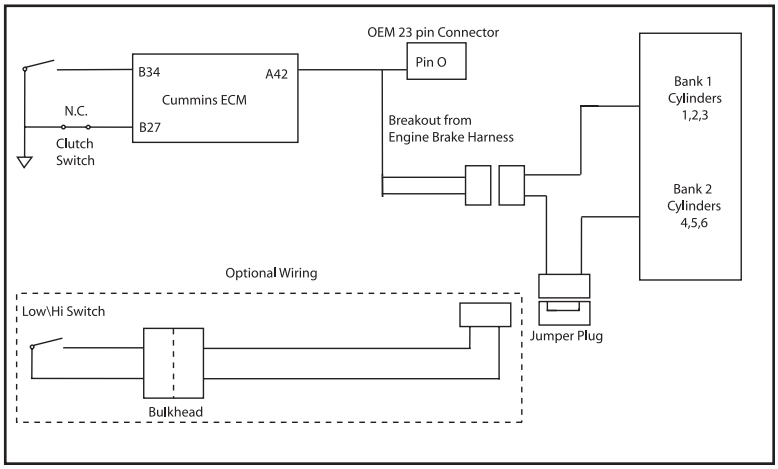


FIG. 10

Wiring for Automatic Allison World AT & HT Transmissions

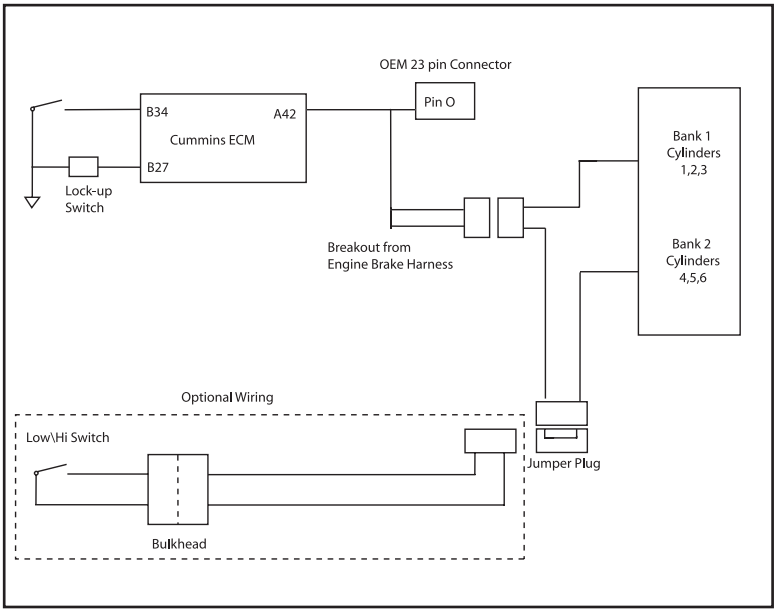


FIG. 11

Wiring for Allison World Transmissions with WTEC III Controllers

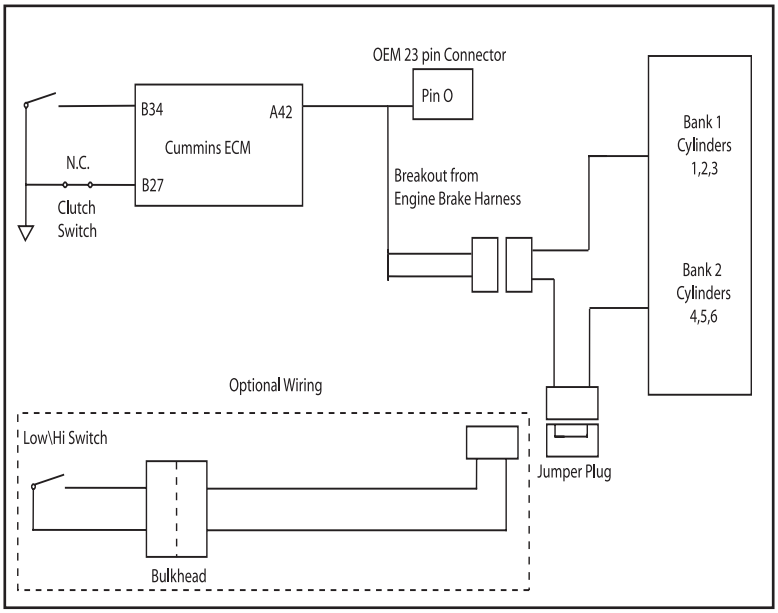


FIG. 12

Wiring for Allison 1000 and 2000 series Transmissions

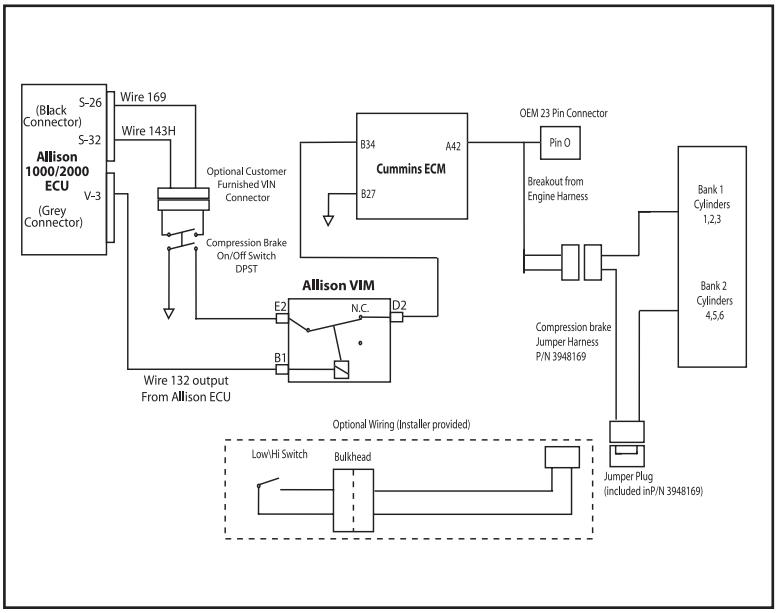


FIG. 13

Section 5: Brake Operation Check

The CBrake by Jacobs™ ISL98/ISL03/ISL07/ISC07 engine installation is now complete. The following procedures and adjustments should be made.

Recheck the housing installation. Be certain no foreign objects have been left behind and all correct clearance requirements have been met.

Bleed and Operation Check

⚠ WARNING

WEAR EYE PROTECTION AND DO NOT EXPOSE YOUR FACE OVER ENGINE AREA. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE DOWN ON THE ENGINE. WHEN ENGINE IS RUNNING AND VALVE COVERS ARE REMOVED, OIL SPLASHING IN THE ENGINE BRAKE AREA COULD CAUSE PERSONAL INJURY.

1. Assure that the control wires are connected to the terminal assemblies in engine brake spacers.

2. Bleed brake housings and check their operation. Start engine and allow to run 5 to 10 minutes, or until the engine has reach proper operating tempature. Accelerate engine to approximately 1800 RPM and release throttle. Both solenoid valves should operate.

3. Repeat this procedure several times to bleed brake housings for immediate operation.

Replace Rocker Lever Cover

1. Install the new gasket and cover on the spacer.Tighten the cover capscrews starting from the center and working out to 12 N•m [9 ft-lb]. (See Fig. 14)

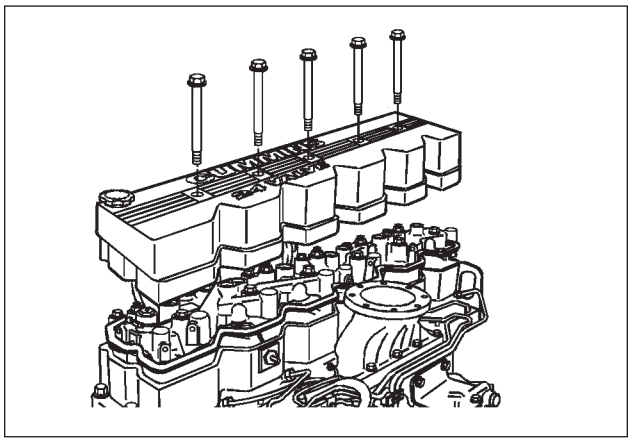


FIG. 14

Section 6: Brake Maintenance

Theory of Operation

Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished through motion transfer using a master/slave piston arrangement which opens cylinder exhaust valves near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

The blowdown of compressed air to atmospheric pressure prevents the return of energy to the engine piston on the expansion stroke. The effect is a net energy loss, since the work done in compressing the cylinder charge is not returned during the expansion process.

Exhaust Blowdown

Referring to Fig. 15, exhaust blowdown occurs as follows:

1. The energized solenoid valve permits engine lube oil to flow under pressure through the control valve to both the master piston and the slave piston.

2. Oil pressure causes the master piston to move down, coming to rest on the exhaust rocker arm adjusting screw.

3. The exhaust rocker arm adjusting screw begins upward travel (as in normal exhaust cycle), forcing the master piston upward and directing high pressure oil to the slave piston. The ball check valve in the control valve imprisons high-pressure oil in the master/slave piston system.

4. The slave piston, under the influence of the high-pressure oil moves down, momentarily opens one exhaust valve while the engine piston is near its top dead-center position, releasing compressed cylinder air to the exhaust manifold.

5. Compressed air escapes out to the atmosphere, completing a compression braking cycle.

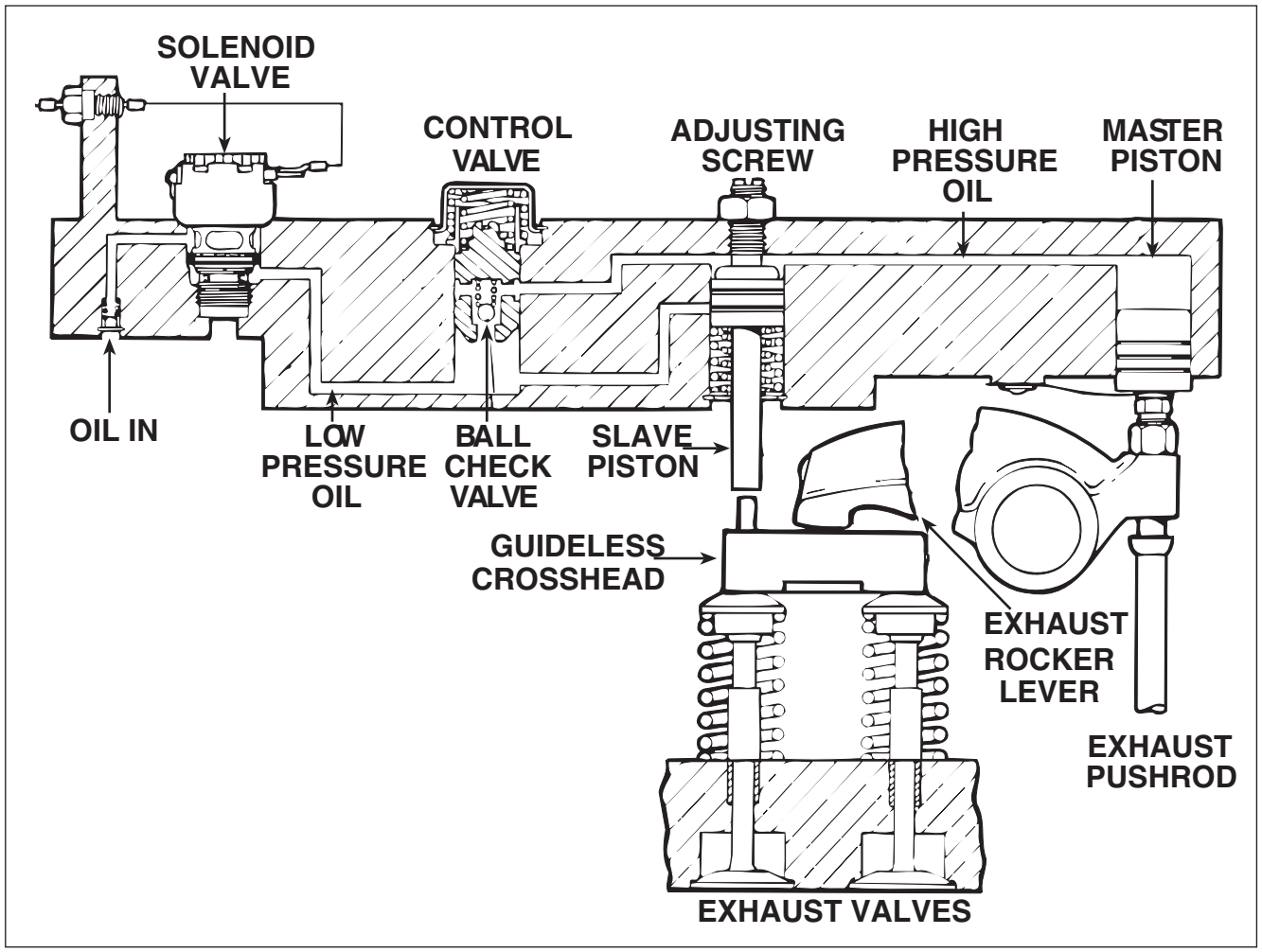


FIG. 15

The CBrake by Jacobs™ is a relatively trouble-free device. However, inspections and routine maintenance will need to be made from time to time. Use the following procedures to keep the engine brake in top condition.

This section will cover how to properly remove, clean and reinstall engine brake components. Use an OSHA-approved cleaning solvent when washing parts. Be sure to coat parts with clean engine oil when reinstalling them.

⚠ WARNING

NEVER REMOVE ANY ENGINE BRAKE COMPONENT WITH ENGINE RUNNING. PERSONAL INJURY MAY RESULT.

NOTE: FIG. 16 IS ACTUAL ISL03 BRAKE. FIG. 17-31 ARE TYPICAL BRAKE COMPONENTS AND NOT SPECIFIC TO ISL03.

Control Valve

⚠ WARNING

REMOVE CONTROL VALVE COVERS CAREFULLY. CONTROL VALVE COVERS ARE UNDER LOAD FROM THE CONTROL VALVE SPRINGS. REMOVE WITH CARE TO AVOID PERSONAL INJURY.

1. Apply pressure on the control valve cover and remove retaining ring using retaining ring pliers (see Fig. 17).

2. Slowly remove cover until spring pressure ceases, then remove the control valve springs and collar (see Fig. 18).

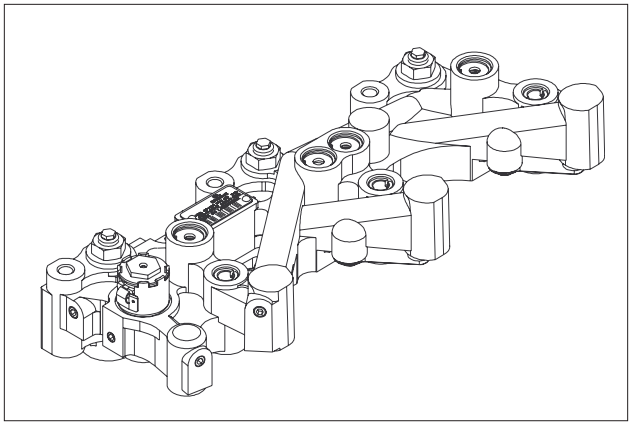


FIG. 16

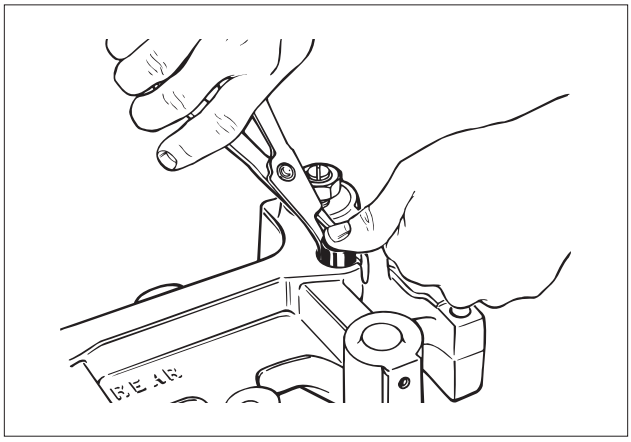


FIG. 17

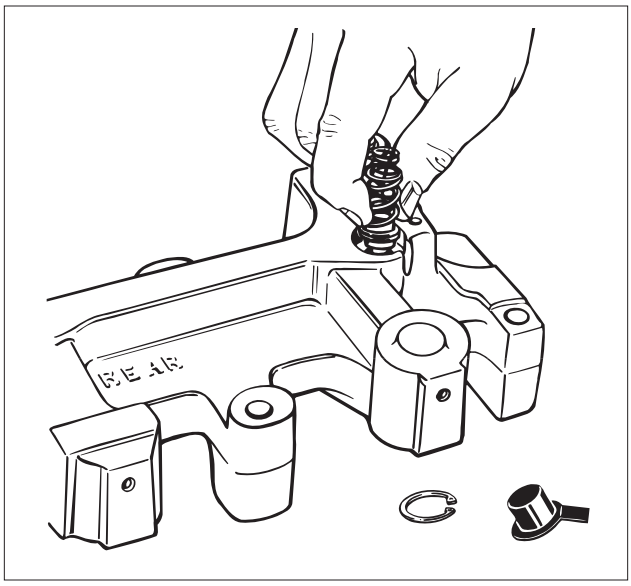


FIG. 18

3. Using needle-nose pliers or a magnet, remove the control valve (see Fig. 19).

4. Wash the control valve with approved cleaning solvent. Push a wire through the hole in the base of the valve to ensure that the ball check is free. The ball should lift with light pressure on the wire. If the ball is stuck or there is no spring pressure, replace the control valve. Dry the valve with compressed air and wipe clean with a paper towel.

5. Thoroughly clean the control valve bore in the housing using clean paper towels.

6. Dip the control valve in clean lube oil. Drop the valve into its bore. If binding occurs, the control valve should be replaced.

7. Reassemble the parts, reversing the removal procedure. Be sure retaining ring ears are positioned opposite the oil drain slot in the housing (see Fig. 20).

NOTE:
BE SURE THE CONTROL VALVE COLLAR IS INSTALLED WITH THE LONGER SLEEVE AREA UP (SEE BELOW). IF THE COLLAR IS INSTALLED UPSIDE DOWN, THIS BRAKE CYLINDER WILL NOT OPERATE.

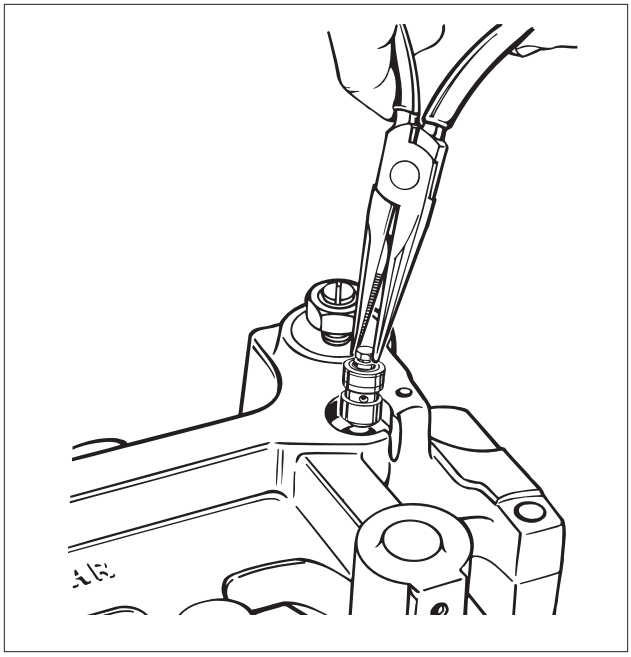
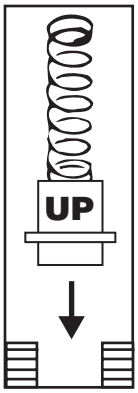


FIG. 19



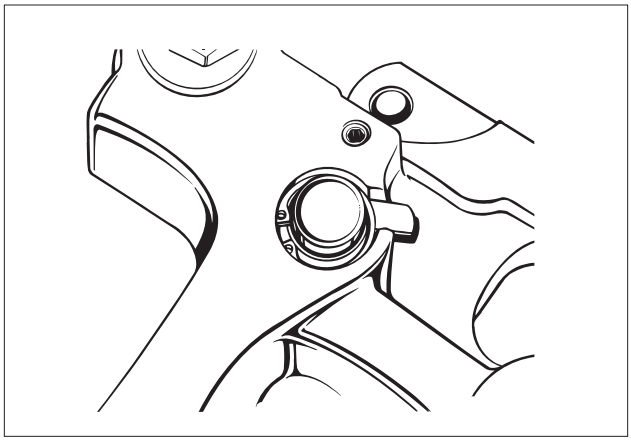


FIG. 20

Solenoid Valve

1. Disconnect the solenoid harness. Using a 3/4” socket and extension, unscrew the solenoid valve (see Fig. 21).

⚠ CAUTION

DO NOT DISASSEMBLE OR TAMPER WITH THE SOLENOID VALVE. ENGINE DAMAGE COULD RESULT.

2. Remove and discard the rubber seal rings (ISL holds three seal rings and ISL03 holds only two) (Fig. 22). If the lower ring (ISL only) stays in the bottom of the housing solenoid bore, remove with a seal pick.

3. Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. Clean and dry the valve with compressed air. Replace oil screen, if necessary.

4. Clean out the solenoid valve bore in the housing. Use clean paper towels. Never use rags, as they may leave lint and residue which can plug the oil passageways.

5. Reinstall the solenoid using new seal rings. Seat lower seal ring (ISL only) in the base of the solenoid valve bore. Wipe clean lube oil into and around the bore. Place upper and center seal rings on the solenoid valve body.

6. Be sure the seals are seated properly and carefully and screw the solenoid into the housing without unseating the seals. Torque the valve to 20 N•m [15 lb.-ft] (see Fig. 23).

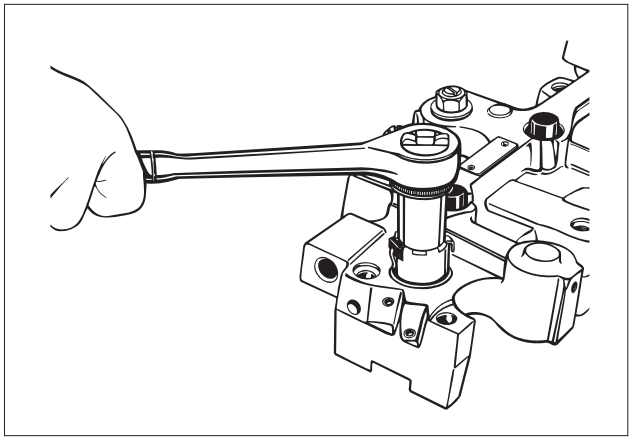


FIG. 21

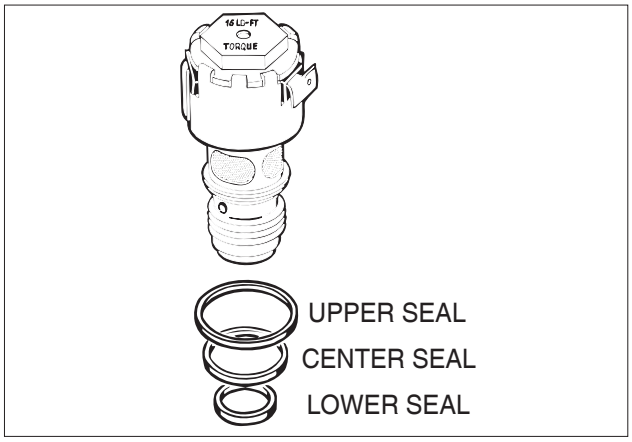


FIG. 22

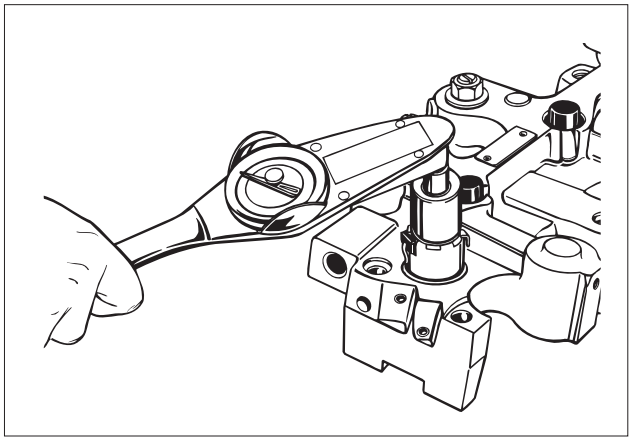


FIG. 23

Slave Piston Adjusting Screws (D Lash)

Loosen slave piston adjusting screw locknut and remove adjusting screw from housing (Fig. 24).

Clean adjusting screw in an approved cleaning solvent.

Inspect the slave piston adjusting screw (D Lash). The plunger should protrude from the bottom of the screw, and move freely (Fig. 25). Be sure the retaining ring is fully engaged in its groove. Replace the entire screw assembly if any defect is found.

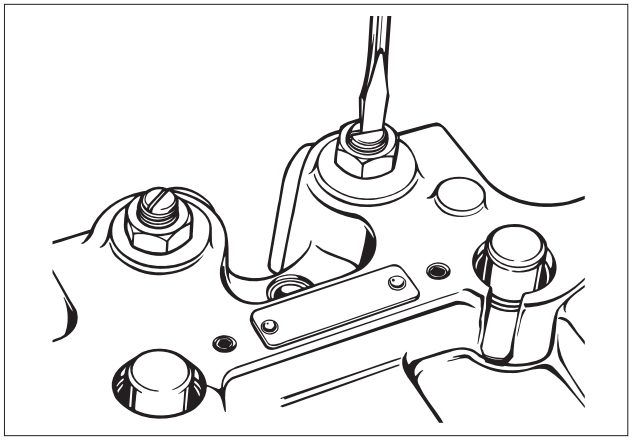


FIG. 24

⚠ CAUTION

DO NOT READJUST OR TAMPER WITH THE ADJUSTING SCREW ASSEMBLY. ENGINE DAMAGE COULD RESULT.

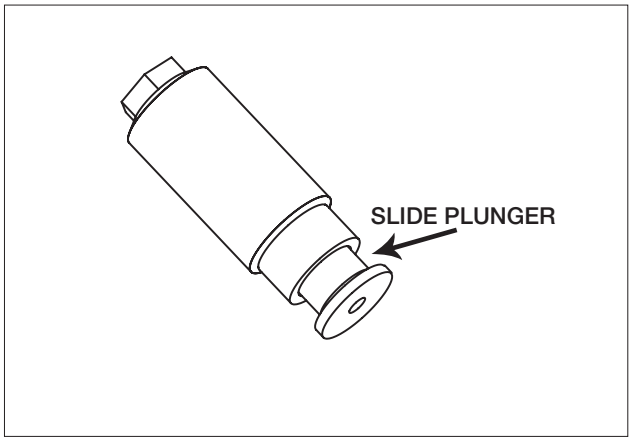


FIG. 25

Master Piston

Remove the button-head screw, washer and master piston spring from bottom of housing.

Remove the master piston from its bore using needle-nose pliers. If binding occurs, check for burrs or contaminants in the lube oil. Clean in an approved cleaning solvent (Fig. 26).

NOTE:
DO NOT ATTEMPT TO REMOVE THE MASTER PISTON WITHOUT FIRST REMOVING THE FLAT SPRING. BENDING THE SPRING BACK TOO FAR CAN DISTORT THE SPRING AND WOULD NEED TO BE REPLACED.

Inspect the hard face surface. A pitted, chipped, cracked or galled piston should be replaced. If the hard facing is damaged, inspect the corresponding rocker arm adjusting screws for excessive wear or pitting. Replace if damaged.

Reassemble in reverse order. When tightening the capscrew, make certain the two spring tabs do not interfere with the sides of the master piston center raised portion (see Fig. 27). Torque the capscrew to 12 N•m [9ft- lb].

NOTE:
THE TABS SHOULD BE EQUALLY SPACED FROM THE RAISED PISTON AREA.

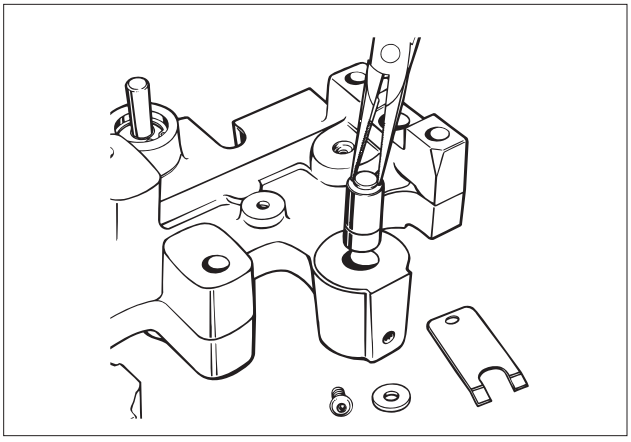


FIG. 26

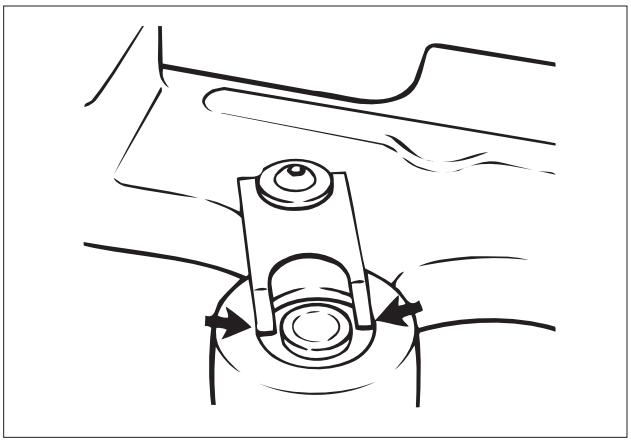


FIG. 27

Slave Piston

⚠ WARNING

WEAR SAFETY GLASSES. REMOVE SLAVE PISTON CAREFULLY. THE SLAVE PISTON IS RETAINED BY SPRINGS THAT ARE UNDER HEAVY COMPRESSION. IF THE FOLLOWING INSTRUCTIONS ARE NOT FOLLOWED AND PROPER TOOLS NOT USED, THE SPRING COULD BE DISCHARGED WITH ENOUGH FORCE TO CAUSE PERSONAL INJURY.

Remove the locknut on the slave piston adjusting screw. Back out the adjusting screw until the slave piston is fully retracted (screw is loose).

Use the slave piston removal tool and the following procedure to remove and replace the slave piston:

1. Place the hole in the clamp bracket over the slave piston adjusting screw (Fig. 28).

2. While holding the tool in position, screw the holder down over the slave piston stem until the retainer is contacted.

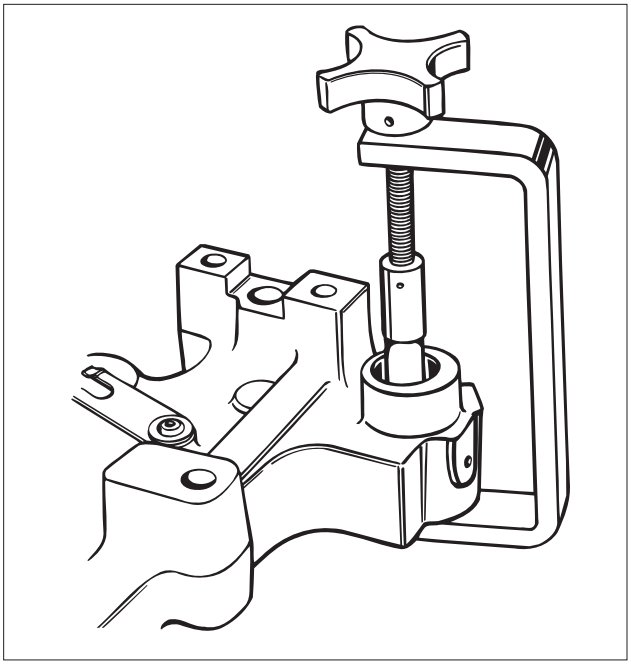


FIG. 28

3. Turn the handle slowly until the retainer is depressed, about 1/32” (1 mm), relieving pressure against the retaining ring.

4. Remove the retaining ring using retaining ring pliers. Back out the holder until the springs are loose. Remove the tool. (see Fig. 29)

5. Remove the retainer, spring and slave piston. Check for nicks or burrs that could cause binding. (see Fig. 30)

6. Clean the piston in an approved cleaning solvent. Run a small wire through any holes. Replace the piston if the ground surface on the outside diameter is scratched or scored.

   NOTE:
   BE SURE ALL COMPONENTS ARE REASSEMBLED IN CORRECT ORDER.

7. Reassemble in reverse order.

8. Use the removal tool to compress the slave piston and springs down until the retainer is about 1/32” (1 mm) below the retaining ring groove (see Fig. 29).

9. Slide the retaining ring over the threaded rod of the removal tool and reinstall the retaining ring in its groove. Be sure the retaining ring is fully engaged in the groove.

10. Remove the tool slowly to ensure proper seating of retaining ring.

11. Assemble the locknut; do not tighten.

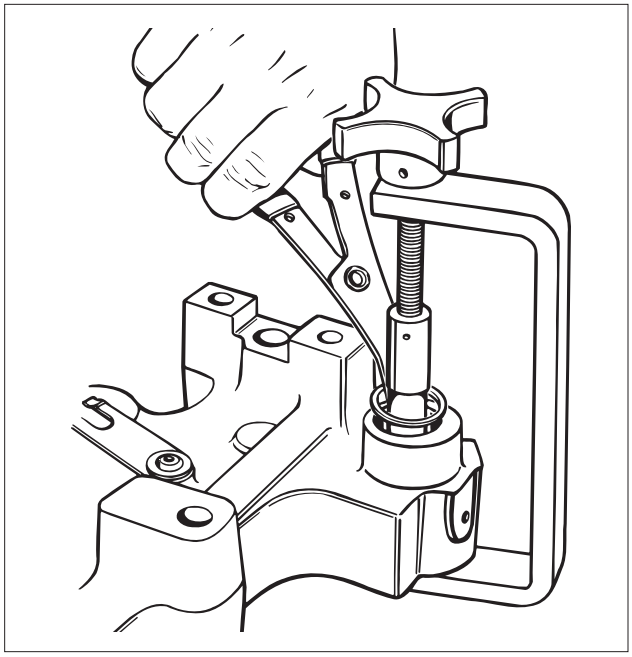


FIG. 29

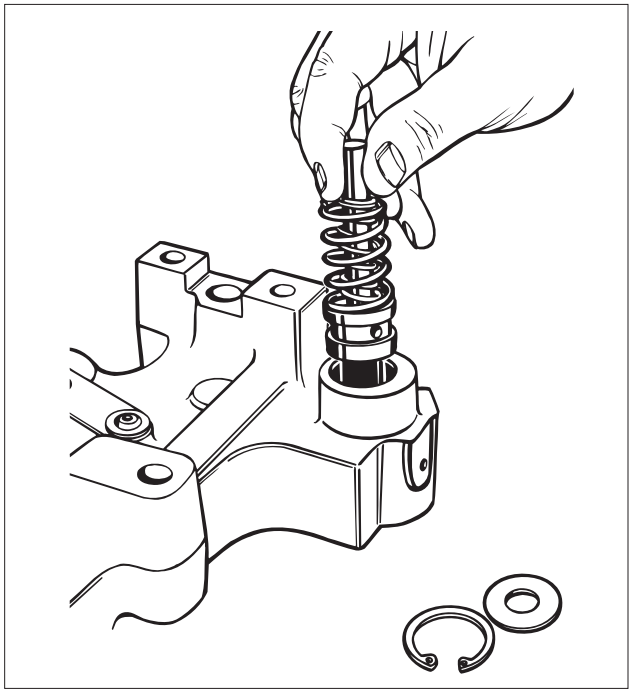


FIG. 30

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